

[Title of Document]

Specification

[Title of Invention]

5 Process for the Preparation of Optical Information Recording Medium, and Optical Information Recording Medium

[Scope of Claims for a Patent]

[Claim 1] A process for the preparation of an optical information recording medium comprising:

10 placing a photo-curable transfer sheet comprising a photo-curable composition which comprises a reactive polymer having a photopolymerizable functional group and which is capable of deforming by application of pressure on an optical information recording substrate having an uneven surface of recorded pits and/or grooves such that one side of the photo-curable transfer sheet is in contact with the uneven surface of the optical information recording substrate,

15 depressing the sheet and substrate to form a laminate in which the one side of the photo-curable transfer sheet adheres closely to the uneven surface, and

20 exposing the photo-curable transfer sheet of the laminate to ultraviolet rays to cure the transfer sheet.

[Claim 2] The process as defined in claim 1, the depressing step is carried out under reduced pressure.

25 [Claim 3] The process as defined in claim 1 or 2, wherein a reflective layer is provided on the uneven surface of the optical information recording substrate.

[Claim 4] A process for the preparation of an optical information recording medium comprising:

30 placing a photo-curable transfer sheet comprising a photo-curable

composition which comprises a reactive polymer having a photopolymerizable functional group and which is capable of deforming by application of pressure on an optical information recording substrate having an uneven surface of recorded pits and/or grooves such that one side of the photo-curable transfer sheet is in contact with the uneven surface of the optical information recording substrate,

depressing the transfer sheet and the substrate to allow the one side of the photo-curable transfer sheet to adhere closely to the uneven surface,

placing a stamper having an uneven surface of recorded pits and/or grooves on the photo-curable transfer sheet such that the uneven surface of the stamper is in contact with a side having no contact with the substrate of the photo-curable transfer sheet,

depressing the substrate, the transfer sheet and the stamper to form a laminate in which the side of the photo-curable transfer sheet adheres closely to the uneven surface of the stamper,

exposing the photo-curable transfer sheet of the laminate to ultraviolet rays to cure the transfer sheet, and

removing the stamper out of the laminate to form unevenness on a surface of the cured photo-curable transfer sheet.

[Claim 5] The process as defined in claim 4, wherein an organic polymer film is further provided on the surface having unevenness of the cured photo-curable transfer sheet through an adhesive layer.

[Claim 6] The process as defined in claim 4, wherein another photo-curable transfer sheet is further depressed on the surface having unevenness of the cured photo-curable transfer sheet and cured by irradiation of ultraviolet light.

[Claim 7] The process as defined in claim 4 or 5, wherein the depressing step is carried out under reduced pressure.

[Claim 8] The process as defined in any of claims 5 to 7, wherein a reflective layer has been provided on the unevenness surface of the substrate,

and a semitransparent reflective layer is further provided on the surface having unevenness of the cured photo-curable transfer sheet.

5 [Claim 9] The process as defined in any of claims 1 to 8, wherein the photo-curable composition has a glass transition temperature of not more than 20°C.

[Claim 10] The process as defined in any of claims 1 to 9, wherein the photo-curable transfer sheet has a light transmittance of not less than 70% in a wavelength range of 380 to 420 nm.

10 [Claim 11] The process as defined in any of claims 1 to 10, wherein the photo-curable transfer sheet has a light transmittance of not less than 70% in a wavelength range of 380 to 800 nm.

[Claim 12] The process as defined in any of claims 1 to 11, wherein the reactive polymer has 1 to 50% by mole of the photopolymerizable functional group.

15 [Claim 13] The process as defined in any of claims 1 to 12, wherein the photopolymerizable functional group is a (meth)acryloyl group.

[Claim 14] The process as defined in any of claims 1 to 13, wherein the photo-curable composition contains 0.1 to 10% by weight of a photopolymerization initiator.

20 [Claim 15] The process as defined in any of claims 1 to 14, wherein the photo-curable transfer sheet has a thickness of 5 to 300µm.

[Claim 16] An optical information recording medium prepared by the process as defined in any of claims 1 to 15.

25 [Detailed Description of the Invention]

[Technical Field]

[0001]

The present invention relates to a process for the preparation of an optical information recording medium, such as DVD (Digital Versatile
30 Disc), CD (Compact Disc), an optical magnetic disc or a hard disc, in

which a large amount of information such as letters, sound and animation is recorded and/or recordable as digital signals.

[Prior Art]

5 [0002]

As an optical information recording medium in which digital signals have been already recorded by forming pits on its surface, CD and CD-ROM are widely used. Recently, DVD that animation can be also recorded by forming pits on its both (double) sides has been noted as the
10 next generation recording medium instead of CD and increasingly used. Further, attention is directed to recordable discs such as CD-R, DVD-R and DVD-RW having groove(s) or grooves and pits thereon.

[0003]

Conventional DVD having recording layers on its both sides includes a disc readable from double sides, as shown in, for example, Fig. 4,
15 in which each of reflective layers 1a, 2a is formed on a surface of signal-pits of each of transparent resin substrates 1, 2 having the surface of signal-pits on its one side, and the two transparent resin substrates 1, 2 are bonded to each other through an adhesive layer 3 such that the reflective
20 layers 1a, 2a face each other; and a disc readable from single side, as shown in, for example, Fig. 5, in which a semitransparent reflective layer 1b is formed on a surface of signal-pits of one transparent resin substrate 1 while a reflective layers 2a is formed on a surface of signal-pits of another transparent resin substrate 2 and the two transparent resin substrates 1, 2
25 are bonded to each other through an adhesive layer 3 such that the semi-transparent reflective layers 1b and the reflective layer 2a face each other.

[0004]

The DVD readable from double sides can be prepared, for example, by subjecting melted polycarbonate resin to injection molding by the use of
30 a stamper having unevenness (concave and convex) corresponding to the

reverse of unevenness of the signal-pit to be recorded on the substrate to prepare a transparent resin substrate having unevenness on its surface, forming a reflective layer on the uneven surface by sputtering metal such as aluminum on it, and bonding two transparent resin substrates obtained in
5 the above manner to each other through an adhesive such that the two reflective layers face each other.

[0005]

A standardized specification of a next generation optical disc "Blue-Ray Disc" was proposed on February 10, 2002. The specification
10 mainly includes storage capacity of 23.3/25/27GB, laser wavelength of 405nm (violet laser), lens numerical aperture (N/A) of 0.85, disc diameter of 120mm, disc thickness of 1.2mm and track pitch of 0.32 μ m.

[0006]

In the Blue-Ray Disc, as mentioned above, the sizes of groove and
15 pits are reduced, and therefore it is required to reduce a spot size of a reading laser. The reduction of the spot size results in that the reading is apt to be influenced by inclination of the disc, and hence even DVD having a little warpage cannot be reproduced (read out). In order to avoid the disadvantage, it may be effective to reduce a thickness of a substrate and make a
20 thickness of a cover layer provided on pits surface on a laser-irradiation side to approx. 0.1mm.

[0007]

"NIKKEI ELECTRONICS, November" 5, 2001, pp.68 describes a process for the preparation of DVD suited to the above-mentioned requirements. The process is explained by referring to Fig. 7. A UV curable resin 5A is provided, by application, on a reflective layer (or recording layer) 6a of a disc substrate (1.1mm) 4a having the reflective layer on its uneven surface, while a UV curable resin 5B is provided, by application, on a stamper 4b made of polycarbonate having uneven surface.
30 Subsequently, after the substrate is turned over, the turned-over substrate

and the stamper are put together, and the UV curable resins 5A, 5B are cured by irradiating ultraviolet beam from the stamper side. The stamper 4b is then removed from the cured UV curable resin 5B, a reflective layer (or recording layer) 6b is formed on the uneven surface and further a cover layer (thickness of approx. 0.1mm) 7 is provided the reflective layer 6b.

[Problem to be solved by the Invention]

[0008]

In the above-mentioned process, a UV curable resin (layer) is provided on a disc substrate and a stamper by application, and the substrate is turned over and bonded to the stamper. Hence, the process is needed to perform complicated procedures such as the application and turning over steps. In more detail, when the turned-over substrate and the stamper are put together through UV curable resins, bubbles are generated in the vicinity of an interface of the combined UV curable resins. Hence it is difficult to successfully bond the UV curable resins of the substrate and stamper to each other. Furthermore, the UV curable resin is accompanied by large shrinkage on its curing, and hence the resultant medium is apt to have deformation such as warpage.

[0009]

In view of the above-mentioned problems, the object of the invention is to provide a process for preparing extremely easily an optical information recording medium in high productivity, which is useful for forming on a disc substrate having an uneven surface a layer having an uneven surface.

[0010]

Further, the object of the invention is to provide a process for the preparation of an optical information recording medium which is capable of transferring easily and precisely an uneven surface of a disc substrate.

[0011]

Furthermore, the object of the invention is to provide a process for the preparation of an optical information recording medium which is capable of transferring successively, easily and precisely an uneven surface of a disc substrate and an uneven surface of a stamper.

5 [0012]

Moreover, the object of the invention is to provide an optical information recording medium scarcely having deformation such as warpage which can be obtained by the above-mentioned process.

[0013]

10 Further, the object of the invention is to provide an optical information recording medium having precisely transferred unevenness and excellent smooth surface, especially an optical information recording medium having a reduced thickness.

15 [Means for Achieving Object]

[0014]

The invention is provided by a process for the preparation of an optical information recording medium comprising:

20 placing a photo-curable transfer sheet comprising a photo-curable composition which comprises a reactive polymer having a photopolymerizable functional group and which is capable of deforming by application of pressure on an optical information recording substrate having the uneven surface of recorded pits and/or grooves such that one side of the photo-curable transfer sheet is in contact with the uneven surface of the optical information recording substrate,

25 depressing the sheet and substrate to form a laminate in which the one side of the photo-curable transfer sheet closely adheres to the uneven surface, and

30 exposing the photo-curable transfer sheet of the laminate to ultraviolet rays to cure the transfer sheet.

[0015]

In the process, the depressing step is generally carried out under reduced pressure, whereby generation of bubbles can be suppressed. Further a reflective layer is preferably provided on the uneven surface of the optical information recording substrate. A recording layer can be provided instead of the reflective layer. In this case, a groove is generally formed instead of pits.

[0016]

The invention is also provided by process for the preparation of an optical information recording medium comprising:

placing a photo-curable transfer sheet comprising a photo-curable composition which comprises a reactive polymer having a photopolymerizable functional group and which is capable of deforming by application of pressure on an optical information recording substrate having an uneven surface of recorded pits and/or grooves such that one side of the photo-curable transfer sheet is in contact with the uneven surface of the optical information recording substrate,

depressing the sheet and substrate to allow the one side of the photo-curable transfer sheet to adhere closely to the uneven surface,

placing a stamper having an uneven surface of recorded pits and/or grooves on the photo-curable transfer sheet such that the uneven surface of the stamper is in contact with a side having no contact with the substrate of the photo-curable transfer sheet,

depressing the substrate, transfer sheet and stamper to form a laminate in which the side of the photo-curable transfer sheet adheres closely to the uneven surface of the stamper,

exposing the photo-curable transfer sheet of the laminate to ultraviolet rays to cure the transfer sheet, and

removing the stamper out of the laminate to form unevenness (e.g., recording pits) on a surface of the cured photo-curable transfer sheet.

[0017]

In the process, it is preferred that an organic polymer film is further provided on the cured surface having an unevenness of the cured photo-curable transfer sheet through an adhesive layer. Moreover, another photo-curable transfer sheet can be further depressed on the cured surface having an unevenness of the cured photo-curable transfer sheet and cured by exposing another transfer sheet to ultraviolet rays. It is preferred that a reflective layer has been provided on the unevenness surface of the substrate, and a semitransparent reflective layer is further provided on the surface having an unevenness of the cured photo-curable transfer sheet. The depressing step is preferably carried out under reduced pressure.

[0018]

In the process, the photo-curable composition of the photo-curable transfer sheet preferably has a glass transition temperature of not more than 20°C, which renders the formation of unevenness by depression at room temperature easy. The photo-curable transfer sheet generally has a light transmittance of not less than 70% in a wavelength rang of 380 to 420nm, preferably in a wavelength rang of 380 to 600nm, especially in a wavelength rang of 380 to 800nm. It is ensured that an optical disc obtained by using the transfer sheet having the light transmittance is read out without error if the disc is done by irradiation of laser. Moreover, the photo-curable transfer sheet generally has cure shrinkage of not more than 8%.

[0019]

Further, the reactive polymer preferably has a glass transition temperature of not more than 20°C. Further the reactive polymer preferably has 1 to 50% by mole of the photopolymerizable functional group whereby appropriate curing property of the polymer or appropriate strength of the cured polymer is ensured. The photopolymerizable functional group generally is a (meth)acryloyl group in terms of curability. The preferred re-

active polymer is an acrylic resin having the photopolymerizable functional group through a urethane bond. The photo-curable composition generally contains 0.1 to 10% by weight of a photopolymerization initiator. The photo-curable transfer sheet preferably has a thickness of 1 to 1,200 μ m, especially 5 to 300 μ m in terms of transferring properties and workability.

[Best Mode for Conducting the Invention]

[0020]

Embodiments of the invention are explained in detail by referring to drawings.

[0021]

Fig. 1 is a section view showing an example of an embodiment of the photo-curable transfer sheet 11 used in the present invention. In Fig. 1, the photo-curable transfer sheet 11 has release sheets 12a, 12b on its both sides. The release sheet may be provided on one side of the photo-curable transfer sheet, and otherwise may not be provided, depending on uses. Particularly, in a continuous preparation, the photo-curable transfer sheet 11 having no release sheets is preferred.

[0022]

The photo-curable transfer sheet 11 is a layer that is easily deformed by application of pressure such that it is capable of following precisely along an uneven surface of a stamper whereby precise transferring is brought about when the photo-curable transfer sheet 11 is depressed on the uneven surface. The photo-curable transfer sheet 11 is especially composed of a photo-curable composition which comprises a reactive polymer having a photopolymerizable functional group and a glass transition temperature of not more than 20°C. Further, the photo-curable transfer sheet 11 has a light transmittance of not less than 70% in a wavelength range of 380 to 420 nm such that information can be easily read out by a reproduction laser and can be recorded in high density. The light transmittance is

preferably not less than 80% in a wavelength range of 380 to 420 nm. Hence, an optical information recording medium obtained by using the transfer sheet can be advantageously used in a process for reproducing pit signals by using a reproduction laser having a laser wavelength in the range of 380 to 420 nm.

[0023]

The optical information recording medium can be prepared using the above photo-curable transfer sheet, for example, as shown in Fig. 2.

[0024]

The release sheet 12a is removed from the photo-curable transfer sheet 11 having release sheets 12a, 152b (step (1)). The photo-curable transfer sheet 11 having release sheet 12b is placed on an optical information recording substrate 21 having an uneven surface as recording pits and a reflective layer 23 (generally reflective layer of Al, Ag or the like having high reflectivity) provided on the uneven surface such that a side having no release sheet of the photo-curable transfer sheet 11 faces the reflective layer, and they are depressed (step (2)). Thus, the side of the photo-curable transfer sheet 11 closely adheres to the uneven surface of the reflective layer to form a laminate (consisting of 11, 213 and 21). The release sheet 12b is removed from the laminate. If this laminate is used in an optical information recording medium, the photo-curable transfer sheet 11 is cured by ultraviolet rays and then the release sheet 12b is removed.

[0025]

Subsequently, a stamper 24 having an uneven surface as recording pits is placed on an uncured surface (having no substrate), where the release sheet 12b is removed, of the photo-curable transfer sheet 11, such that the uneven surface faces the uncured surface of optical information recording substrate, and they are depressed (step (3)). Thus, the surface of the photo-curable transfer sheet 51 closely adheres to the uneven surface of the stamper 24 to form a laminate (consisting of 21, 23, 11 and 24). The

photo-curable transfer sheet of the laminate is then cured by irradiation of ultraviolet rays (step (4)), and the stamper 24 is removed from the laminate to form unevenness such as recording pits on a surface of the cured sheet. Thus the optical information recording medium consisting of the substrate 21, the reflective layer 23 and the cured transfer sheet 11 is obtained. In general, a silver-alloy reflective layer (semitransparent reflective layer) 25 is formed on the unevenness (surface of the cured sheet), and further an organic polymer film (cover layer) 26 is bonded onto the silver-alloy reflective layer 25 through an adhesive layer (step (5)). On the surface of the cured sheet having recording pits, a photo-curable transfer sheet may be further depressed, and cured by irradiation of ultraviolet rays. Otherwise, on the surface of the cured sheet, a UV curable resin may be further coated, and cured.

[0026]

In the above process, the optical information recording medium exclusively used for reproduction is explained. However, an optical information recording medium used for recording (writing) is also prepared in the same manner as the above process. In the recordable medium, for example, grooves or grooves and pits is provided instead of the pits, and a metal recording layer is provided instead of the reflective or semitransparent reflective layer. When the recording layer is a dye-recording layer, a recording layer and reflective layer are generally provided. Besides these points, the recordable medium can be also prepared in the same manner as above.

[0027]

In the invention, the photo-curable transfer sheet 11 is configured such that the uneven shape of recorded pits of a substrate 21 can be precisely transferred to the photo-curable transfer sheet 11 by depressing (preferably under reduced pressure) the sheet onto the stamper at low temperature of 100°C or less (preferably room temperature). Superposition of

the substrate 21 and the photo-curable transfer sheet 51 is generally carried out using a pressure rollers or easy press (preferably under reduced pressure). The photo-curable transfer sheet 11 after curing is fairly stuck to metal used in the reflective layer, and is not easily peeled from the reflective layer. If necessary, an adhesion-promoting layer may be provided on the reflective layer.

[0028]

In the invention, the photo-curable transfer sheet 11 is configured such that the uneven shape of recorded pits of the stamper 24 can be precisely transferred to photo-curable transfer sheet 11 by depressing (preferably under reduced pressure) the sheet onto the stamper at low temperature of 100°C or less (preferably room temperature). Superposition of the stamper 24 and the photo-curable transfer sheet 11 is generally carried out using a pressure rollers or easy press (preferably under reduced pressure). The photo-curable transfer sheet 11 after curing is weakly stuck to metal such as nickel used in the stamper, and therefore the photo-curable transfer sheet 11 can be easily peeled from the stamper 24.

[0029]

The substrate 21 generally is a thick plate (generally thickness of 0.3 to 1.5mm, especially approx. 1.1mm), and therefore it can be prepared by conventional injection molding. However, it may be prepared by using the photo-curable transfer sheet and a stumper. Since the thickness of the optical information recording substrate can be rendered small (300μm or less, especially 150μm or less) by using the photo-curable transfer sheet, another substrate is prepared by conventional injection molding and therefore its thickness is increased whereby precision of transferred pit shape can be enhanced.

[0030]

In the process, when the photo-curable transfer sheet is depressed on the substrate, or when the stamper is depressed on the photo-curable

transfer sheet , it is preferred to carry out the depressing or superposing operation under reduced pressure whereby bubbles generated in the operation can be easily removed.

[0031]

5 The depressing operation under the reduced pressure can be performed by a method comprising passing the photo-curable transfer sheet and stamper between two rolls under reduced pressure; or by a method comprising placing a stamper in a mold of a vacuum molding device and contact bonding a photo-curable transfer sheet to the stamper under reduced pressure.

[0032]

 Further, the depressing operation under the reduced pressure can be performed using a device according to a double vacuum chamber system. The operation is explained by referring to Fig. 4. Fig. 4 shows a laminator according to a double vacuum chamber system. The laminator is provided with a lower chamber 41, an upper chamber 42, a sheet of silicone rubber 43 and a heater 45. A laminate 49 consisting of a substrate having unevenness and a photo-curable transfer sheet provided thereon or laminate of substrate/transfer sheet/stamper is placed in the lower chamber 41 of the laminator. Both the upper chamber 42 and lower chamber 41 are degassed or decompressed. The laminate 49 is heated with a heater 45, and air is introduced into the upper chamber 42 to allow the chamber to be at atmospheric pressure while the lower chamber 41 is kept under reduced pressure, whereby the laminate is depressed to be contact bonded. After cooling, the laminate is taken out and transformed to the next step. This operation permits sufficient deaeration under reduced pressure, and therefore, the substrate and the photo-curable transfer sheet can be contact bonded without bubbles.

[0033]

30 The photo-curable transfer sheet used in the invention preferably

comprises a photo-curable composition which comprises a reactive polymer having a photopolymerizable functional group and a glass transition temperature of not more than 20°C.

[0034]

5 The photo-curable composition is generally composed mainly of the reactive polymer having a photopolymerizable functional group, a compound (e.g., monomer or oligomer) having a photopolymerizable functional group (preferably (meth)acryloyl group), a photopolymerization initiator and if necessary other additives.

10 [0035]

 Examples of the reactive polymer having a photopolymerizable functional group include homopolymers or copolymers (i.e., acrylic resins having a photopolymerizable functional group) derived from alkyl acrylate (e.g., methyl acrylate, ethyl acrylate, butyl acrylate, 2-ethylhexyl acrylate) and/or alkyl methacrylate (e.g., methyl methacrylate, ethyl methacrylate, butyl methacrylate, 2-ethylhexyl methacrylate) and having a photopolymerizable functional group on its main chain or side chain. These (co)polymers can be obtained, for example, by copolymerizing one or more (meth)acrylate mentioned above with (meth)acrylate (e.g., 2-hydroxyethyl (meth)acrylate) having a functional group such as -OH and reacting the resultant polymer with a compound (e.g., isocyanatoalkyl (meth)acrylate) having a functional group capable of reacting with the functional group of the polymer and having a photopolymerizable functional group. Thus an acrylic resin having a photopolymerizable functional group through a urethane bond is preferred.

25

[0036]

 The reactive polymer of the invention has generally 1 to 50% by mole, preferably 5 to 30% by mole of the photopolymerizable functional group. Examples of the photopolymerizable functional group preferably include acryloyl, methacryloyl and vinyl groups, especially acryloyl and

30

methacryloyl groups.

[0037]

In case the reactive polymer having glass transition temperature of not more than 20°C is used as above, the resultant photo-curable transfer
5 layer having flexibility can follow exactly the uneven surface of the stamper even at room temperature when the sheet is depressed on the stamper. The reactive polymer especially has glass transition temperature of 15 to -50°C because the resultant photo-curable layer can follow more exactly the uneven surface. When the glass transition temperature ex-
10 ceeds the upper limit, high pressure and temperature is needed in the depressing and bonding steps of the sheet, which brings about lowering of workability. When the glass transition temperature falls to below the lower limit, the resultant cured sheet does not have sufficient hardness.

[0038]

15 The reactive polymer of the invention generally has number-average molecular weight of 5,000 to 1,000,000, preferably 10,000 to 300,000, and/or generally has weight-average molecular weight of 5,000 to 1,000,000, preferably 10,000 to 300,000.

[0039]

20 Examples of the compounds having a photopolymerizable group include (meth)acrylate monomers such as 2-hydroxyethyl (meth)acrylate, 2-hydroxypropyl (meth)acrylate, 4-hydroxybutyl (meth)acrylate, 2-ethylhexylpolyethoxy (meth)acrylate, benzyl (meth)acrylate, isobornyl (meth)acrylate, phenyloxyethyl (meth)acrylate, tricyclodecane
25 mono(meth)acrylate, dicyclopentenylloxyethyl (meth)acrylate, tetrahydrofurfuryl (meth)acrylate, acryloylmorpholine, N-vinylcaprolactam, 2-hydroxy-3-phenyloxypropyl (meth)acrylate, o-phenylphenyloxyethyl (meth)acrylate, neopentylglycol di(meth)acrylate, neopentyl glycol dipropoxy di(meth)acrylate, neopentyl glycol hydroxypivalate di(meth)acrylate,
30 tricyclodecanedimethylol di(meth)acrylate, 1,6-hexanediol di(meth)acrylate,

nonanediol di(meth)acrylate, trimethylolpropane tri(meth)acrylate, pentaerythritol tri(meth)acrylate, pentaerythritol tetra(meth)acrylate, tris[(meth)acryloxyethyl]isocyanurate and ditrimethylolpropane tetra(meth)acrylate; and

5 the following (meth)acrylate oligomer such as:

polyurethane (meth)acrylate such as compounds obtained by reaction of:

a polyol compound (e.g., polyol such as ethylene glycol, propylene glycol, neopentyl glycol, 1,6-hexanediol, 3-methyl-1,5-pentanediol, 10 1,9-nonanediol, 2-ethyl-2-butyl-1,3-propanediol, trimethylolpropane, diethylene glycol, dipropylene glycol, polypropylene glycol, 1,4-dimethylolcyclohexane, bisphenol-A polyethoxydiol and polytetramethylene glycol; polyesterpolyol obtained by reaction of the above-mentioned polyol and polybasic acid or anhydride thereof such as 15 succinic acid, maleic acid, itaconic acid, adipic acid, hydrogenated dimer acid, phthalic acid, isophthalic acid and terephthalic acid; polycaprolactone polyol obtained by reaction of the above-mentioned polyol and ϵ -caprolactone; a compound obtained by reaction of the above-mentioned polyol and a reaction product of the above-mentioned polybasic acid or 20 anhydride thereof and ϵ -caprolactone; polycarbonate polyol; or polymer polyol), and

an organic polyisocyanate compound (e.g., tolylene diisocyanate, isophorone diisocyanate, xylylene diisocyanate, diphenylmethane-4,4'-diisocyanate, dicyclopentanyl diisocyanate, hexamethylene 25 diisocyanate, 2,4,4'-trimethylhexamethylene diisocyanate, 2,2',4'-trimethylhexamethylene diisocyanate), and

hydroxyl-containing (meth)acrylate (e.g., 2-hydroxyethyl (meth)acrylate, 2-hydroxypropyl (meth)acrylate, 4-hydroxybutyl (meth)acrylate, 2-hydroxy-3-phenyloxypropyl (meth)acrylate, cyclohexane-1,4-dimethylolmono(meth)acrylate, pentaerythritol tri(meth)acrylate or 30

glycerol di(meth)acrylate);

bisphenol-type epoxy(meth)acrylate obtained by reaction of bisphenol-A epoxy resin or bisphenol-F epoxy resin and (meth)acrylic acid.

These compounds having photopolymerizable functional group can be employed singly or in combination of two or more kinds.

[0040]

Any photopolymerization initiators known can be used in the invention. The initiators having good storage-stability after mixing with other components are preferred. Examples of the photopolymerization initiators include acetophenone type initiators such as 2-hidroxy-2-methyl-1-phenylpropane-1-on, 1-hydroxycyclohexylphenylketone and 2-methyl-1-[4-(methylthio)phenyl]-2-morphorino-propane-1-on; benzoin type initiators such as benzylmethyleketal; benzophenone type initiators such as benzophenone, 4-phenylbenzophenone and hydroxybenzophenone; thioxanthone type initiators such as isopropylthioxanthone and 2,4-diethylthioxanthone. Further, as special type, there can be mentioned methylphenylglyoxylate. Especially preferred are 2-hidroxy-2-methyl-1-phenylpropane-1-on, 1-hydroxycyclohexylphenylketone, 2-methyl-1-[4-(methylthio)phenyl]-2-morphorinopropane-1-on and benzophenone. These photopolymerization initiators can be employed together with one or more kinds of a photopolymerization promoter such as a benzoic acid type compound (e.g., 4-dimethylaminobenzoic acid) or a tertiary amine compound by mixing the initiator with the promoter in optional ratio. Only the initiator can be employed singly or in combination of two or more kinds. The initiator is preferably contained in the photo-curable composition in the range of 0.1 to 20% by weight, particularly 1 to 10% by weight.

[0041]

In addition to the above-mentioned photopolymerizable initiators,

the acetophenone type initiator includes 4-phenoxydichloroacetophenone, 4-t-butylchloroacetophenone, 4-t-butyltrichloroacetophenone, diethoxyacetophenone, 2-hydroxy-2-methyl-1-phenylpropane-1-on, 1-(4-isopropylphenyl)-2-hydroxy-2-methylpropane-1-on, 1-(4-dodecylphenyl)-2-hydroxy-2-methylpropane-1-on, 4-(2-hydroxyethoxy)-phenyl(2-hydroxy-2-propyl)ketone, 1-hydroxycyclohexylphenylketone, 2-methyl-1-[4-(methylthio)phenyl]-2-morpholino-propane-1-on; and the benzophenone type initiators include benzophenone, benzoylbenzoic acid, methyl benzoylbenzoate, 4-phenylbenzophenone, hydroxybenzophenone, 4-benzoyl-4'-methylphenylsulfide and 3,3'-dimethyl-4-methoxybenzophenone.

[0042]

The acetophenone type initiators preferably are 2-hydroxy-2-methyl-1-phenylpropane-1-on, 1-hydroxycyclohexylphenylketone, 2-methyl-1-[4-(methylthio)phenyl]-2-morpholinopropane-1-on, and the benzophenone type initiators preferably are benzophenone, benzoylbenzoic acid and methyl benzoylbenzoate. Preferred examples of the tertiary amine compounds of the photopolymerization promoter include triethanolamine, methyldiethanolamine, triisopropanolamine, 4,4'-dimethylaminobenzophenone, 4,4'-diethylaminobenzophenone, ethyl 2-dimethylaminobenzoate, ethyl 4-dimethylaminobenzoate, (n-butoxy)ethyl 4-dimethylaminobenzoate, isoamyl 4-dimethylaminobenzoate and 2-ethylhexyl 4-dimethylaminobenzoate. Especially preferred are ethyl 4-dimethylaminobenzoate, (n-butoxy)ethyl 4-dimethylaminobenzoate, isoamyl 4-dimethylaminobenzoate and 2-ethylhexyl 4-dimethylaminobenzoate. As mentioned above, three kinds of components of the photopolymerizable initiators can be combined.

[0043]

The photo-curable composition of the invention is preferably configured such that the photo-curable transfer sheet has a glass transition temperature of not more than 20°C and the photo-curable transfer sheet has a transmittance of not less than 70%. Therefore the photo-curable composition preferably contains, in addition to the compound having a photo-polymerizable functional group and the photopolymerization initiator, if desired the following thermoplastic resin and other additives.

[0044]

The ratio by weight of the reactive polymer : the compound having a photopolymerizable functional group : the photopolymerization initiator generally is 40-100 : 0-60 : 0.1-10, especially 60-100 : 0-40 : 1-10.

[0045]

As other additives, a silane coupling agent can be used for enhancing the adhesive strength. Examples of the silane coupling agent include vinyltriethoxysilane, vinyltris(β -methoxyethoxy)silane, γ -methacryloxypropylmethoxysilane, vinyltriacetoxysilane, γ -glycidoxypropyltrimethoxysilane, γ -glycidoxypropyltriethoxysilane, β -(3,4-epoxycyclohexyl)ethyltrimethoxysilane, γ -chloropropylmethoxysilane, vinyltrichlorosilane, γ -mercaptopropylmethoxysilane, γ -aminopropyltriethoxysilane, N- β -(aminoethyl)- γ -aminopropyltrimethoxysilane. The silane coupling agent can be used singly, or in combination of two or more kinds. The silane coupling agent is preferably used in the range of 0.01 to 5 weight by part based on 100 parts by weight of the above reactive polymer.

[0046]

Similarly, an epoxy group-containing compound can be used for enhancing the adhesive strength. Examples of the epoxy group-containing compounds include triglycidyl tris(2-hydroxyethyl)isocyanurate, neopentylglycol diglycidyl ether, 1,6-hexanediol diglycidyl ether, allyl glycidyl ether, 2-ethylhexyl glycidyl

ether, phenyl glycidyl ether, phenol glycidyl ether, p-tert-butylphenyl glycidyl ether, diglycidyl adipate, diglycidyl o-phthalate, glycidyl methacrylate and butyl glycidyl ether. Further, the similar effect is also obtained by using an oligomer having an epoxy group and molecular weight of hundreds to thousands, or a polymer having an epoxy group and molecular weight of thousands to hundreds of thousands. The content of the compound having an epoxy group is sufficient in the range of 0.1 to 20 parts by weight based on 100 parts by weight of the reactive polymer, particularly 1 to 10% by weight. At least one of the compounds having an epoxy group can be used singly or in combination of two or more kinds.

[0047]

As other additives, further a hydrocarbon resin can be used for improving processing properties such as laminating properties. The hydrocarbon resin may be either natural resin or synthetic resin. Examples of the natural resins preferably include rosins, rosin derivatives and terpene resins. Examples of the rosins include gum resins, tall oil resins, wood resins. Examples of the rosin derivatives include hydrogenated rosins, disproportionated rosins, polymerized rosins, esterificated rosins, metal salts of rosins. Examples of the terpene resins include α -pinene resins, β -pinene resins, and terpene phenol resins. Moreover, as the natural resin, dammar, copal, shellac can be used. Examples of the synthetic resins preferably include petroleum resins, phenol resins, and xylene resins. Examples of the petroleum resins include aliphatic petroleum resins, aromatic petroleum resins, cycloaliphatic petroleum resins, copolymer type petroleum resins, hydrogenated petroleum resins, pure monomer type petroleum resins, and coumarone-indene resins. Examples of the phenol resins include alkylphenol resins and modified phenol resins. Examples of the xylene resins include xylene resins and modified xylene resins.

[0048]

Furthermore, acrylic resin can be employed in the invention. For

example, homopolymers and copolymers obtained from alkyl acrylate(s) such as methyl acrylate, ethyl acrylate and butyl acrylate and/or alkyl methacrylate(s) such as methyl methacrylate, ethyl methacrylate and butyl methacrylate can be used. Copolymers of these monomers and other co-
5 polymerizable monomers can be also used. In view of reactivity in the photo curing step and durability and transparency of cured product, polymethyl methacrylate (PMMA) is preferred.

[0049]

The above-mentioned polymer such as hydrocarbon resin can be
10 used in the amount of 1 to 20 parts by weight, preferably 5 to 15 parts by weight based on 100 parts by weight of the reactive polymer.

[0050]

The photo-curable composition may contain, in addition to the above-mentioned additives, an ultraviolet absorber, an aging resistant agent,
15 a dye, and a processing auxiliary agent in a small amount. If desired, particles of silica gel, calcium carbonate or silicone copolymer may be contained in a small amount.

[0051]

The photo-curable transfer sheet comprising the photo-curable
20 composition of the invention is generally prepared by homogeneously mixing the reactive polymer, a compound having a photopolymerizable functional group (monomer and oligomer) and if desired other additives, kneading the mixture using an extruder or roll, and subjecting the kneaded mixture to a film-forming process using a calendar, roll, T-die extrusion or
25 inflation to form a film of a predetermined dimension. When a support is used, it is needed to form a film on the support. A more preferred process for forming the photo-curable sheet comprises the steps of: dissolving homogeneously the components in a good solvent, applying the resultant solution onto a separator coated closely with silicone or fluoric resin (or the
30 support) by means of flow-coater method, roll-coater method, gravure-roll

method, mayer-bar method or lip-die coating method, and vaporizing the solvent.

[0052]

The thickness of the photo-curable transfer layer generally is in the range of 1 to 1,200 μ m, preferably 5 to 500 μ m, especially 5 to 300 μ m (further 150 μ m or less). When the thickness is thinner than 1 μ m, sealing properties are lowered and maybe the sheet does not full up the unevenness of the transparent substrate. When the thickness is thicker than 1,200 μ m, the thickness of the resultant recording medium is so thick whereby trouble in housing or storing of the medium and the resultant assembly or reverse influence in light transmittance possibly occurs.

[0053]

It is preferred to bond the release sheets to the both sides of the photo-curable transfer sheet.

[0054]

The release sheet preferably comprises transparent organic resin having a glass transition temperature of not less than 50°C. The release sheet generally is a transparent resin sheet mainly consisting of organic resin such as polyester resin (e.g., polyethylene terephthalate, polycyclohexylene terephthalate, polyethylene naphthalate), polyamide (e.g., nylon 46, modified nylon 6T, nylon MXD6, polyphthalamide), ketone resin (e.g., polyphenylene sulfide, polythioether sulfone), sulfone resin (e.g., polysulfone, polyether sulfone), polyether nitrile, polyarylate, polyether imide, polyamideimide, polycarbonate, polymethyl methacrylate, triacetylcellulose, polystyrene or polyvinyl chloride. Of these resins, polycarbonate, polymethyl methacrylate, polyvinyl chloride, polystyrene and polyethylene terephthalate can be preferably employed. The thickness is generally in the range of 10 to 200 μ m, especially in the range of 30 to 100 μ m.

[0055]

The substrate having uneven surface used in the invention prefera-

bly comprises transparent organic resin having a glass transition temperature of not less than 50°C. The substrate generally is a transparent resin sheet mainly consisting of organic resin such as polyester resin (e.g., polyethylene terephthalate, polycyclohexylene terephthalate, polyethylene naphthalate), polyamide (e.g., nylon 46, modified nylon 6T, nylon MXD6, polyphthalamide), ketone resin (e.g., polyphenylene sulfide, polythioether sulfone), sulfone resin (e.g., polysulfone, polyether sulfone), polyether nitrile, polyarylate, polyether imide, polyamideimide, polycarbonate, polymethyl methacrylate, triacetylcellulose, polystyrene or polyvinyl chloride.

Of these resins, polycarbonate, polymethyl methacrylate, polyvinyl chloride, polystyrene and polyethylene terephthalate are excellent in transferring properties and birefringence, and therefore can be preferably employed. The thickness is generally in the range of 200 to 2,000µm, especially in the range of 50 to 1,500µm.

[0056]

The material of the organic polymer film preferably comprises transparent organic resin having a glass transition temperature of not less than 50°C. The film generally is a transparent resin sheet mainly consisting of organic resin such as polyester resin (e.g., polyethylene terephthalate, polycyclohexylene terephthalate, polyethylene naphthalate), polyamide (e.g., nylon 46, modified nylon 6T, nylon MXD6, polyphthalamide), ketone resin (e.g., polyphenylene sulfide, polythioether sulfone), sulfone resin (e.g., polysulfone, polyether sulfone), polyether nitrile, polyarylate, polyether imide, polyamideimide, polycarbonate, polymethyl methacrylate, triacetylcellulose, polystyrene or polyvinyl chloride. Of these resins, polycarbonate, polymethyl methacrylate, polyvinyl chloride, polystyrene and polyethylene terephthalate are excellent in transparency and birefringence, and therefore can be preferably employed. The thickness is generally in the range of 10 to 200µm, especially in the range of 50 to 100µm.

[0057]

The photo-curable transfer sheet of the invention obtained as above generally comprises the photo-curable composition containing the reactive polymer of a glass transition temperature of not more than 20°C. Further, the photo-curable transfer layer generally has a light transmittance of not less than 70% in a wavelength rang of 380 to 800nm. In more detail, by setting the glass transition temperature of the reactive polymer to not more than 20°C, the resultant photo-curable transfer sheet having flexibility can follow exactly the uneven surface of the stamper even at room temperature when the sheet is depressed on the stamper. Especially, in the case of the glass transition temperature of 15 to -50°C, the properties following exactly the uneven surface of the stamper is further improved. When the glass transition temperature is so high, high pressure and temperature is needed in the depressing or bonding operation whereby the workability is reduced. When the glass transition temperature is so low, the resultant sheet after curing does not have sufficient hardness.

[0058]

As described above, the photo-curable transfer sheet generally has a light transmittance of not less than 70% in a wavelength rang of 380 to 420nm, preferably 380 to 800nm, whereby reduction of the strength of signals to be read out with a laser beam can be prevented. Further, the sheet preferably has a light transmittance of not less than 80% in a wavelength rang of 380 to 420nm.

[0059]

The reactive polymer of the photo-curable composition preferably has 1 to 50% by mole of polymerizable functional group, whereby the cured photo-curable transfer sheet has strength capable of holding its shape. The photopolymerization initiator is preferably used in the amount of 0.1 to 10% by weight as described previously. The amount of less than the lower limit causes workability to reduce owing to slow curing rate, whereas the amount of more than the upper limit causes the transfer precision to re-

duce.

[0060]

The photo-curable transfer sheet of the invention can be offered as a film precisely controlled in the thickness, and therefore it is possible to easily and precisely bond the sheet to the uneven surface such as the substrate or stamper. This bonding can be easily carried out by depressing the sheet and stamper by means of easy method using pressure rollers or easy press to temporarily bond them at temperature of 20 to 100°C, and then curing the sheet by exposing it to light at room temperature for one to tens seconds. Further, the temporarily bonded laminate is free from occurrence of slippage or peeling between of the sheet and stamper or substrate owing to its specific adhesion, and hence the laminate can be freely handled until the light-curing step.

[0061]

In case the photo-curable transfer sheet of the invention is cured, it is possible to adopt, as light source used, various sources generating light in the wavelength range of ultraviolet to visible rays. Examples of the sources include super-high-pressure, high-pressure and low-pressure mercury lamps, a chemical lamp, a xenon lamp, a halogen lamp, a mercury halogen lamp, a carbon arc lamp, and an incandescent electric lamp, and laser beam. The exposing time is generally in the range of a few seconds to a few minutes, depending upon kinds of the lamp and strength of light.

[0062]

To promote the curing, the laminate may be heated beforehand for 30 to 80°C, and then the heated laminate may be exposed to ultraviolet rays.

[0063]

The metal reflective layer of the invention is formed on an uneven surface of the resultant cured photo-curable transfer sheet having the uneven surface by metallizing (e.g., sputtering, vacuum deposition,

ion-plating). Examples of the metal materials include aluminum, gold, silver or alloy thereof. The semitransparent reflective layer provided on the sheet is generally formed by using silver as metal. In more detail, the semitransparent reflective layer is required to have low reflectivity compared with the reflective layer, and therefore is formed by changing the materials and/or the thickness.

[0064]

When the organic polymer film is bonded onto the reflective layer of the cured sheet, an adhesive is applied onto one of the film and the sheet, and the other is superposed on the adhesive layer, which is cured. When the adhesive is UV-curable resin, it is cured by UV irradiation, and when the adhesive is hot-melt type, it is applied to the reflective layer under heating and then cooled.

[0065]

In the preparation of the optical information recording medium of the invention, it is continuously processed in the form of sheet and finally punched out in the form of disc. However, it may be processed in the form of disc when processing under reduced pressure is required.

[0066]

[EXAMPLE]

The invention is illustrated in detail using the following Examples.

[Example 1]

<Preparation of photo-curable transfer sheet>

(Preparation of reactive polymer)

Formulation I

| | |
|-----------------------------|--------------------|
| 2-ethylhexyl methacrylate | 70 parts by weight |
| methyl methacrylate | 20 parts by weight |
| 2-hydroxyethyl methacrylate | 10 parts by weight |
| benzophenone | 5 parts by weight |
| toluene | 30 parts by weight |

ethyl acetate 30 parts by weight
[0067]

A mixture of the above Formulation I was heated to 60°C with moderately stirring to initiate the polymerization, and stirred at this temperature for 10 hours to provide acrylic resin having a hydroxyl group on its side chain. Then, 5 parts by weight of Calens MOI (2-isocyanatoethyl methacrylate; available from Showa Denko K.K.) was added to the solution of the acrylic resin, and reacted with each other in an atmosphere of nitrogen at 50°C with moderately stirring to provide a solution 1 containing a reactive polymer having a photopolymerizable functional group.
[0068]

The resultant reactive polymer has Tg of 0°C, and 5% by mole of methacryloyl group on its side.
[0069]

15 Formulation II

| | |
|-----------------------------------|---------------------|
| solution 1 of reactive polymer | 100 parts by weight |
| tricyclodecane diacrylate | 30 parts by weight |
| 1-hydroxycyclohexyl phenyl ketone | 1 part by weight |

The above Formulation was homogeneously dissolved to give a mixture, which was applied onto a release sheet (thickness: 75μm; trade name: No. 23, available from Fujimori Kogyo) and dried to form a photo-curable transfer sheet of thickness of 20±2μm. Further, the above release sheet was bonded onto a reverse side of the photo-curable transfer sheet having release sheet.

25 [0070]

<Preparation of optical information recording medium>

One of the release sheets of the photo-curable transfer sheet was removed. The photo-curable transfer sheet was disposed on an Al reflective layer (thickness: 70nm) formed on an unevenness surface of a polycarbonate substrate (thickness: 1.1mm) having the uneven surface as pits
30

such that the surface having no release sheet faced the Al reflective layer, and the photo-curable transfer sheet was depressed on the polycarbonate substrate using a roller made of silicone rubber under load of 2kg to form a laminate (corresponding to the step of (2) in Fig. 2).

5 [0071]

The other release sheet was removed from the resultant laminate. A stamper made of nickel and having an uneven surface as pits was disposed on an exposed surface of the transfer sheet of the laminate such that the uneven surface faced the exposed surface, and then the stamper was depressed on the laminate using a roller made of silicone rubber under load of 2kg to form a laminate, whereby the uneven surface of the stamper was transferred to the surface of the transfer sheet.

[0072]

Subsequently, the photo-curable transfer sheet of the laminate provided with the stamper was exposed to UV-rays of a metal-halide lamp under the condition of an integrated amount of light of $1,000\text{mJ}/\text{cm}^2$ and as a result, the transferred photo-curable transfer sheet was cured.

[0073]

The stamper was removed from the laminate. Silver alloy was spattered on the uneven surface of the cured photo-curable transfer sheet to form a semitransparent reflective layer of silver alloy. A polycarbonate film (thickness: $70\mu\text{m}$; Pure Ace C110-70, available from TEIJIN LTD.) was contact bonded to the semitransparent reflective layer through an adhesive.

25 [0074]

Thus, an optical information recording medium having two uneven surfaces was prepared.

[0075]

[Example 2]

30 <Preparation of photo-curable transfer sheet>

(Preparation of reactive polymer)

Formulation I'

| | | |
|---|-----------------------------|--------------------|
| | n-hexyl methacrylate | 50 parts by weight |
| | 2-hydroxyethyl methacrylate | 50 parts by weight |
| 5 | benzophenone | 5 parts by weight |
| | toluene | 30 parts by weight |
| | ethyl acetate | 30 parts by weight |

A mixture of the above Formulation I' was heated to 60°C with moderately stirring to initiate the polymerization, and stirred at this temperature for 10 hours to provide acrylic resin having a hydroxyl group on its side chain. Then, 50 parts by weight of Carends MOI (2-isocyanatoethyl methacrylate; available from Showa Denko K.K.) was added to the solution of the acrylic resin, and reacted with each other in an atmosphere of nitrogen at 50°C with moderately stirring to provide a solution 2 containing a reactive polymer having a photopolymerizable functional group.

[0076]

The resultant reactive polymer has Tg of 5°C, and 50% by mole of methacryloyl group on its side.

20 [0077]

Formulation II'

| | | |
|--|-----------------------------------|---------------------|
| | solution 2 of reactive polymer | 100 parts by weight |
| | 1,6-hexanediol dimethacrylate | 10 parts by weight |
| | 1-hydroxycyclohexyl phenyl ketone | 1 part by weight |

25 An above Formulation II' was uniformly dissolved to give a mixture, which was applied onto a film of Pure Ace C110-70 (thickness: 70μm; available from TEIJIN LTD.) and dried to form a photo-curable transfer sheet of thickness of 30±2μm. Thus, the resultant photo-curable transfer sheet had the release sheet and therefore the total thickness was

30 100±2μm.

[0078]

<Preparation of optical information recording medium>

An optical information recording medium was obtained in the same manner in Example 1 except for using the above photo-curable transfer
5 sheet.

[0079]

[Comparison Example 1]

<Preparation of optical information recording medium>

A liquid UV-curable adhesive (SD-661; available from DAINIP-
10 PON INK AND CHEMICALS, INC.) was applied onto disposed on an Al reflective layer (thickness: 70nm) formed on an unevenness surface of a polycarbonate substrate (thickness: 1.1mm) having the uneven surface as pits, whereby a UV-curable resin layer A having a thickness of 10 μ m was formed.

15 [0080]

A liquid UV curable adhesive (SD-661; available from DAINIP-
PON INK AND CHEMICALS, INC.) was applied onto disposed on an unevenness surface of a stamper having the uneven surface as pits, whereby a UV curable resin layer B having a thickness of 10 μ m was
20 formed.

[0081]

The resultant substrate and the stamper were laminated on each other such that the UV curable resin layers A and B faced each other to provide a laminate.

25 [0082]

Subsequently, the UV curable resin layers A and B of the laminate were exposed to UV-rays of a metal-halide lamp under the condition of an integrated amount of light of 2,000mJ/cm² and as a result, the resin layers were cured.

30 [0083]

The stamper was removed from the laminate. Silver alloy was spattered on the uneven surface of the cured UV curable resin layers B to form a semitransparent reflective layer of silver alloy. A polycarbonate film (thickness: 70 μ m; Pure Ace C110-70, available from TEIJIN LTD.) was bonded to the semitransparent reflective layer through an adhesive.

[0084]

Thus, an optical information recording medium having two uneven surfaces was prepared.

[0085]

10 <Evaluation of optical information recording substrate and medium>

(1) Light transmittance (wavelength of 380 to 420 nm)

Light transmittance of one optical-curable transfer sheet is measured in the wavelength of 380 to 420 nm according to JIS K6717. Light transmittance of 70% or more is marked as \circ , and Light transmittance of less than 70% is marked as \times .

[0086]

(2) Roughness of land portion

A land portion of a uneven surface on which pits were formed is evaluated on its smoothness using AFM (atomic force microscope). Land portion having sufficient smoothness is marked as \circ , and land portion having poor smoothness is marked as \times .

[0087]

(3) Readout of signals

The information of the resultant optical information recording medium is read out using a laser beam of wavelength of 405nm to obtain its wavy pattern. This wavy pattern is compared with that of the stamper. The wavy pattern of the medium coincident with that of the stamper is marked as \circ , and the wavy pattern of the medium little coincident with that of the stamper is marked as \times .

30 [0088]

The obtained results are shown in Table 1.

[0089]

Table 1

| | Example 1 | Example 2 | Com. Example 1 |
|------------------------------------|-----------|-----------|----------------|
| Light transmittance (380-420nm) | ○ | ○ | ○ |
| Roughness of land | ○ | ○ | × |
| Readout of signals | ○ | ○ | × |

5

The optical information recording medium obtained in Comparison Example 1 has disadvantages of difficultly removing bubbles generated during the laminating step, and of having poor transparency and increased warpage, compared with the media obtained in Examples 1 and 2. Therefore the medium of Comparison Example 1 is considered to be poor in the evaluated characteristics.

10

[Effect of the invention]

[0090]

15

As described above, by the process for the preparation of the photo-curable transfer sheet according to the invention, a further layer having an uneven surface can be formed extremely easily and in high productivity on an uneven surface of a disc substrate. Further, the process of the invention permits an uneven surface of a disc substrate or a stamper to be easily and precisely transferred to the transfer sheet without generation of bubbles. Thus the resultant optical information recording substrate or medium has a signal surface (uneven surface) to which an uneven shape of a stamper or substrate is precisely transferred. Accordingly, an optical information recording medium prepared from the process scarcely brings about occurrence of error when the information (signals) is read out.

20

25

Moreover, the process of the invention makes it possible to easily and precisely cover an uneven surface of a disc substrate. Further, the photo-curable transfer sheet used in the process of the invention has excellent dimension stability due to reduced shrinkage compared with a conventional UV-curable resin, and hence the process provides an optical information recording medium free from deformation such as warpage.

[Brief Description of the Drawings]

[Fig. 1] Fig. 1 is a section view showing an example of an embodiment of a photo-curable transfer sheet according to the present invention.

[Fig. 2] Fig. 2 is a section view showing an example of a process for the preparation of the optical information recording medium according to the invention.

[Fig. 3] Fig. 3 is a section view showing an example of the optical information recording medium according to the invention.

[Fig. 4] Fig. 4 is a schematic view for explaining a depressing method using a device according to a double vacuum chamber system.

[Fig. 5] Fig. 5 is a section view showing an example of a conventional optical information recording medium.

[Fig. 6] Fig. 6 is a section view showing another example of a conventional optical information recording medium.

[Fig. 7] Fig. 7 is a section view showing a procedure for preparing a conventional optical information recording medium described in NIKKEI ELECTRONICS.

[Brief Description of the reference numbers]

| | |
|-----------|-----------------------------------------|
| 11: | Photo-curable transfer sheet |
| 12a, 12b: | Release sheet |
| 21: | Optical information recording substrate |
| 23: | Reflective layer |

| | | |
|----|---------|------------------------------------------------------------------|
| | 24: | Stamper |
| | 25: | Silver-alloy reflective layer (Semitransparent reflective layer) |
| | 26: | Organic polymer film (cover layer) |
| 5 | 1, 2: | Transparent resin substrate |
| | 1a, 2a: | Reflective layer |
| | 3: | Adhesive layer |
| | 1b: | Semitransparent layer |
| | 4a: | Disc substrate |
| 10 | 5A, 5B: | UV curable resin |
| | 6a: | Reflective layer (or recording layer) |
| | 7: | Cover layer |

[Title of Document] Abstract

[Abstract]

[Object]

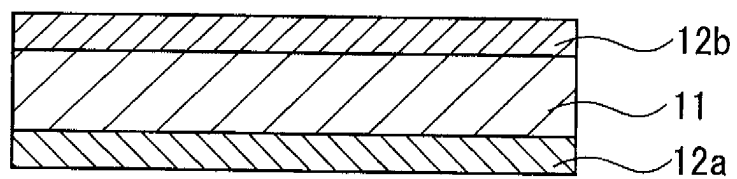
5 The object of the invention is to provide a process for preparing extremely easily an optical information recording medium in high productivity, which is useful for forming on a disc substrate having an uneven surface a layer having an uneven surface.

[Means for Achieving the Object]

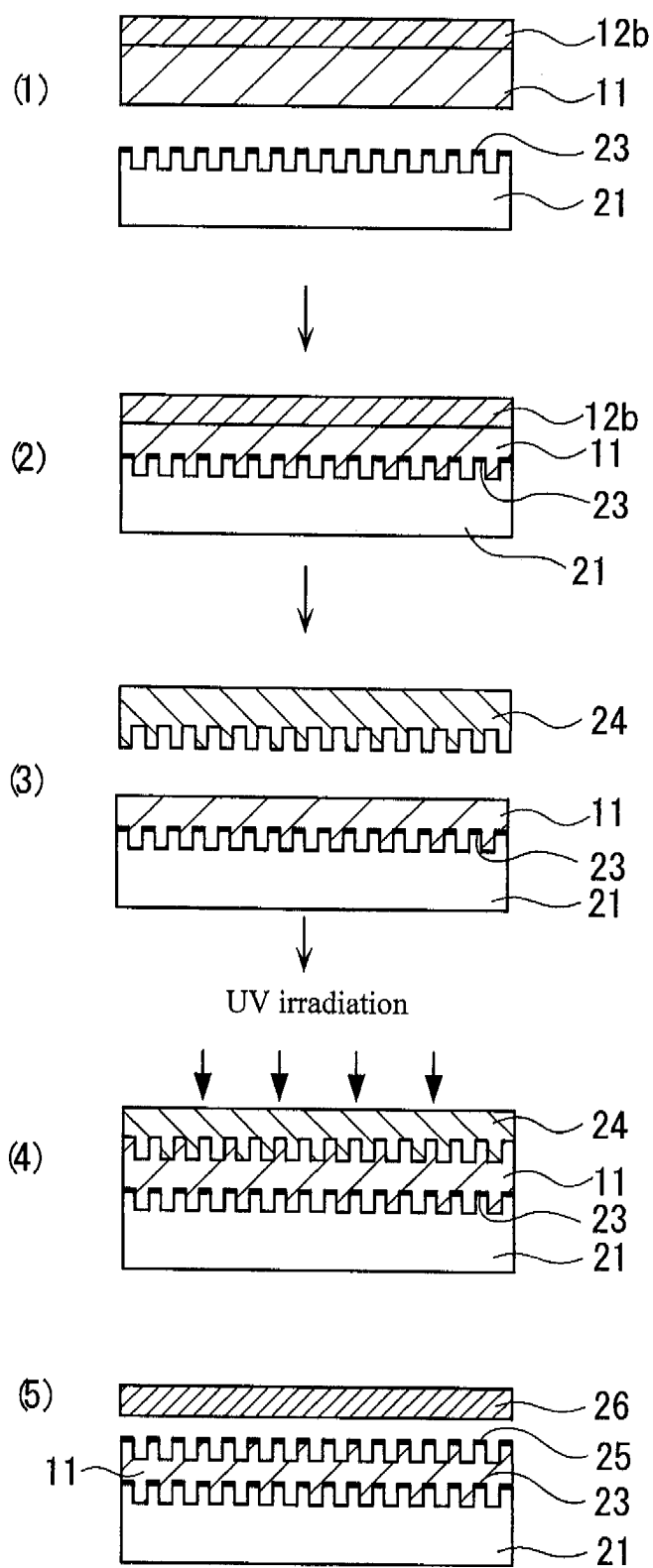
10 A process for the preparation of an optical information recording medium comprising: placing a photo-curable transfer sheet comprising a photo-curable composition which comprises a reactive polymer having a photopolymerizable functional group and which is capable of deforming by application of pressure on an optical information recording substrate having
15 an uneven surface of recorded pits and/or grooves such that one side of the photo-curable transfer sheet is in contact with the uneven surface of the optical information recording substrate, depressing the sheet and substrate to form a laminate in which the one side of the photo-curable transfer sheet adheres closely to the uneven surface, and exposing the photo-curable
20 transfer sheet of the laminate to ultraviolet rays to cure the transfer sheet.

[Selected Figure] Fig. 2

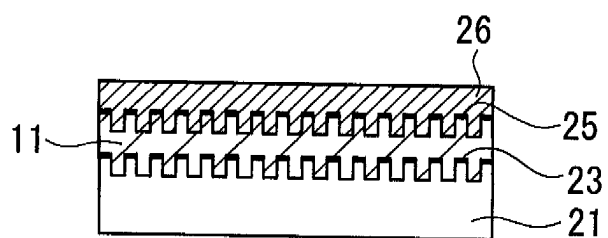
【Fig. 1】



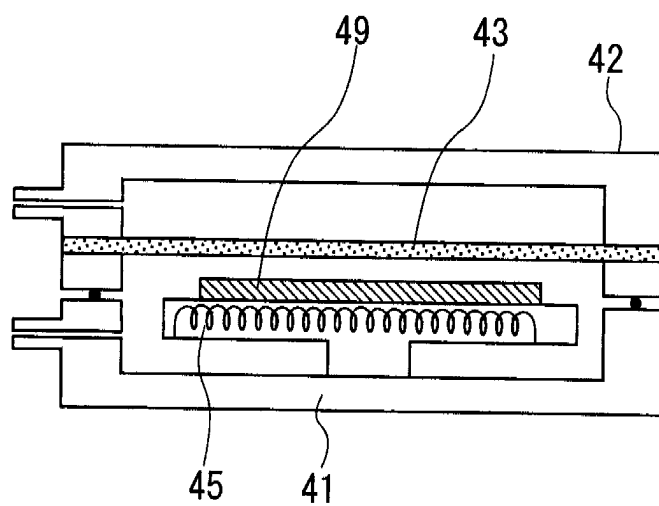
【Fig.2】



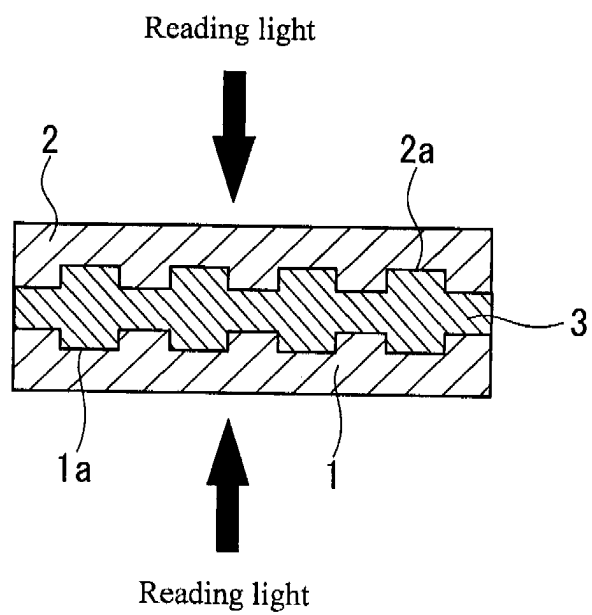
【Fig.3】



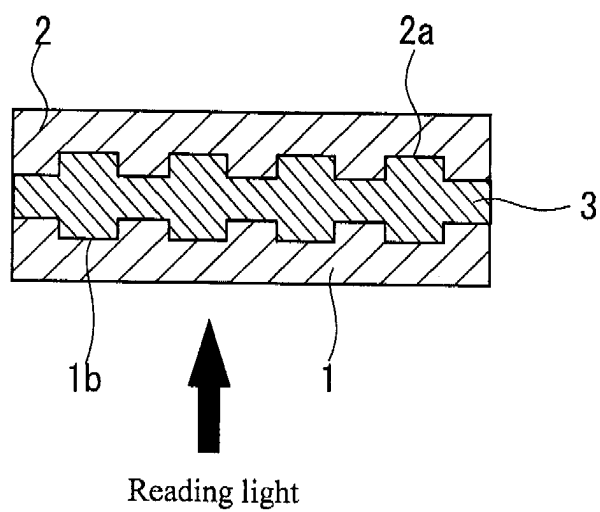
【Fig.4】



【Fig.5】



【Fig.6】



【Fig.7】

